Signature dependent prolate-oblate interaction strength in ^{185}Hg

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In the ^{185}Hg nucleus, bands based upon the $i_{13/2}$ neutron coupled to both prolate and oblate shape coexist at low excitation energy. The published level scheme [1] shows unusual features which are difficult to understand and appear to imply a very small interaction between the coexisting shapes [2]. This is inconsistent with the large values for the interaction observed in ^{187}Hg [3] and the even-mass mercury isotopes [4].

Last year's annual report presented the preliminary results of our 8π experiment investigating ^{185}Hg, in particular, the observation of a new $\frac{17}{2}^+$ state. Further work during 1999 has shown that the published [1] order for the decay of two of the low-lying transitions in ^{185}Hg is incorrect, so that the lowest $\frac{17}{2}^+$ state previously assigned at E_x=484 keV does not exist, but is replaced by a $\frac{15}{2}^+$ state at 531 keV.

These changes make the nature of the shape coexistence in ^{185}Hg very clear, with the band structures very similar to ^{187}Hg [3]. However, there is one surprise, namely, there is clear evidence for a signature dependence of the prolate-oblate interaction strength. Figure 1 shows the mixing matrix element between the prolate and oblate states deduced using the measured $E2$ transition branching ratios and the rotational formalism discussed in Ref. [2], as a function of the assumed ratio of the quadrupole moments of the shape coexisting bands. The four curves in each panel comprise two pairs of upper and lower limits on the interaction strength deduced from the measured interband/intraband $E2$ branching ratios out of the two $\frac{21}{2}^+$ states and the two $\frac{19}{2}^+$ states. Consistent results are obtained only when the quadrupole moments are in the ratio $\sim$ 1 to 2, indicative of shape coexistence. The interactions are found to be 97 and 10 keV for the favoured and unfavoured signatures, respectively. There have so far been no serious attempts to calculate the interaction strength between shape coexisting states, despite its fundamental importance. The unexpected signature-dependence observed here may shed light on how to approach such a calculation.

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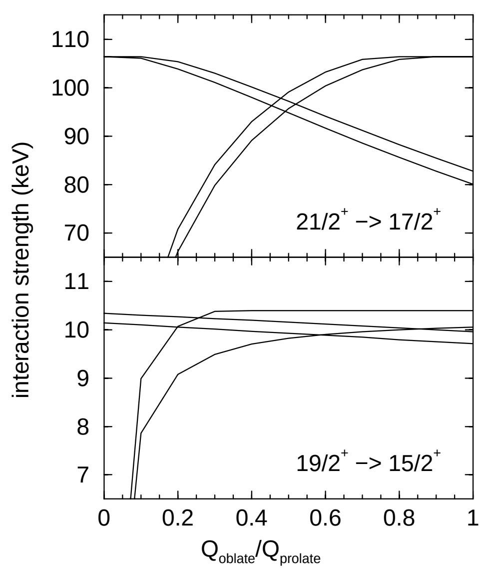

Figure 1: Interaction strengths deduced from the measured $E2$ branching ratios for decay from states in ^{185}Hg as a function of the ratios of the quadrupole moments of the two relevant bands. The regions where the limits overlap constrain both the interaction strength and the ratio Q_{obl}/Q_{prol}.